



Driving disease emergence: will land-use changes beat climate change to the punch?

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In this issue of the *New Zealand Medical Journal*, Winkworth in her article “Land-use change and emerging public health risks in New Zealand: assessing *Giardia* risks”¹ highlights two important points on which we would like to elaborate.

First, a global problem that often takes a back seat to issues such as climate change is the continuous modification of the natural environment due to land-use changes. These can have direct and indirect impacts on ecosystems, with downstream effects not only on the environment and the economy, but also on human health. Human activities can profoundly alter ecosystem functioning, on which we depend for the provision of basic services underpinning human well-being. Winkworth and a number of other researchers argue that land-use changes have contributed to the recent emergence or re-emergence of many infectious diseases.¹⁻³

The second point is that investigations of health problems can often be assisted by taking a multidisciplinary approach. We would go further and state that a multidisciplinary (and multisector) approach is fundamental to adequately address wider human health issues. Such an approach makes it possible to identify interventions further up the causal chain, which ultimately may provide more cost-effective public health strategies than those treating solely the symptoms of the problem.

New threats to human health associated with components of global environmental change are not a recent phenomenon. Humans have been modifying the natural landscape for millennia, and it is argued that previous societies may have brought about their own demise, mainly via population growth and deforestation leading to degraded water supplies and increased incidence of water- and vector-borne diseases.⁴ Similarly, one of the primary forces altering the environment in the 21st Century is land-use change, particularly through accelerated urbanisation.⁵

Changes in land-use not only alter the basic physical properties of the environment (e.g. hydrology, soil structure, and topography), but also the biological make-up of an ecosystem, including the pathogenic and parasitic biota. These changes in turn lead to a disruption of the ecosystem and may increase human exposure to vectors and pathogens.

However, urbanisation is not the only form of land-use change altering human disease risk. Human activities such as agriculture, industry and mining, and their associated inputs (run-off or byproducts) into freshwater ecosystems can directly affect human health. Such activities are associated with increased incidence of water-borne diseases, including more frequent *Cryptosporidium* outbreaks, increased *Giardia* prevalence, and possible water-borne transmission of *Campylobacter*.⁶ *Giardia* in

particular, is a common protozoan agent distributed worldwide that is associated with a high disease burden.

The prevalence of infection for *Giardia* ranges from 1% to 30% in different parts of the world, with the highest levels occurring in countries with poor sanitation.⁷ The parasite can be acquired via drinking or swallowing contaminated water, eating uncooked contaminated food, or via contact with an infected person. In New Zealand, giardiasis is one of the most commonly notified enteric diseases and rates are high compared to other developed countries.⁸ Surveys of New Zealand's freshwaters indicate that the pathogen is widespread in the environment.⁹

It has long been recognised that water-borne pathogens in New Zealand are intricately linked to local ecological dynamics. *Campylobacter* for instance, exhibits complex spatial and temporal patterns of environmental prevalence and infection in humans. For this organism, land-use changes are considered a more significant driver of disease emergence than climate change.¹⁰ In the case of *Giardia*, Winkworth argues that environmental modification associated with land-use changes may be increasingly driving water-borne exposure to this pathogen. At worst therefore, climate change may compound the already significant burden of disease.

Also, as pointed out by Winkworth, a co-ordinated approach using different disciplines would likely make a more significant contribution to the investigation of emerging human health issues. For example, to devise the optimal response (or set of responses) to any particular ecosystem disruption, one requires a detailed understanding of that ecosystem. It is therefore advisable that multi-disciplinary investigations are carried out when considering the potential human health impacts associated with significant land-use changes.

In such scenarios, ecological studies are valuable for examining the distribution and abundance of a pathogen in a particular ecosystem, as well as its interactions with other species and the abiotic environment, thus providing a better understanding of the dynamics of a potential infectious disease. Therefore, in devising medical and public health responses, it would be useful to follow true and tried ecological principles.¹¹

The adoption of multidisciplinary (and multisector) approaches is consequently a fundamental tool to tackle wider human health issues. Solutions to health problems would likely flourish with a cross-disciplinary approach incorporating fields such as Medical and Veterinary Sciences, Environmental Health, Ecology, Geography, Social Sciences and Commerce,¹² and it is good to note that there are examples of this happening in New Zealand.

The importance of such a holistic approach has recently received wider recognition, leading to a number of global initiatives to further this cause (e.g. www.oneworldonehealth.org; www.onehealthinitiative.com). Unfortunately, it seems that currently ecosystem health is still lagging behind the interests of animal and human health, and it needs to be placed more firmly on the agenda.

Without healthy ecosystems, human societies will not be able to attain the necessary services to safeguard human well-being. Consequently, as exemplified from Winkworth's article, land-use change may be a bigger elephant in the room than is

climate change and multi-disciplinary approaches to address emerging infectious diseases are more urgently required than ever.

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